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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/023,548	12/17/2001	Arvind Halliyal	AF01120	5462

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EXAMINER	
KIELIN, ERIK J	

ART UNIT	PAPER NUMBER
2813	7

DATE MAILED: 12/19/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/023,548	Applicant(s) HALLIYAL ET AL.	
	Examiner Erik Kielin	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 October 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) *2-4 and 14-21* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 and 5-13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

This action is responsive to Amendment A with drawing corrections and substitute drawing sheet, each filed 15 October 2002.

Election/Restrictions

1. Newly submitted claims 14-21 directed to an invention that is independent or distinct from the invention originally claimed for the reasons indicated in the action filed 8 July 2002. Claims 14-16 and 18-21 were drawn to non-elected species, as indicated by Applicant in the response submitted 16 July 2002. Claim 17 was amended to depend from non-elected claim 14, and for this reason is withdrawn from further consideration as being drawn to a non-elected claim. Moreover, claim 1 is no longer generic to originally filed or amended claims 14-21.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 14-21 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Drawings

2. The proposed drawing correction and/or the proposed substitute sheets of drawings, filed on 15 October 2002 have been approved.

3. The corrected or substitute drawings were received on 15 October 2002. These drawings are acceptable.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1, 5-12, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 4,918,503 (**Okuyama**) in view of **Van Zant**, Microchip Fabrication, 4th ed. McGraw-Hill: New York, 2000, pp. 172-173, 179-182, 480-487.

Regarding claim 1, **Okuyama** discloses a process for fabrication of a semiconductor device including an ONO structure, comprising forming the ONO structure by:

providing a semiconductor substrate **11** having a silicon surface **45** (Figs. 2A-2C);

forming a first oxide layer **14** on the silicon surface using steam oxidation (col. 2, lines 34-39);

depositing a silicon nitride layer **15** about 60-120 Å (6 to 12 nm) thick on the first oxide layer (col. 2, lines 59-62) ; and

forming a top oxide layer **16** of 20-60 Å thick on the silicon nitride layer, wherein the top oxide layer is formed by a steam oxidation of a surface of the silicon nitride layer **204** (col. 2, lines 34-39). (See also col. 4, line1 to col. 6, line 39.)

Okuyama does not indicate the method by which the steam oxidation is performed.

Van Zant teaches that the preferred method of performing steam oxidation for cleanliness and control of the process is by providing a mixture of hydrogen (H_2) and oxygen (O_2) which react in the chamber (i.e. *in situ*) to form water as steam. (See pp. 172-173.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use the ISSG method of forming steam for the wet oxidation of **Okuyama** for the beneficial reasons just indicated in **Van Zant**.

Regarding claims 5, 6, and 8, the claims state that the dielectric stack is "carried out in an RTP and RTCVD chamber" (claims 5 and 8) or is "carried out in a single-wafer cluster tool" (claims 6 and 8). These limitations are not considered to have patentable weight because it has been held that to be entitled to weight in method claims, the recited structure limitations therein must affect the method in a manipulative sense, and not amount to the mere claiming of a use of a particular structure. See Ex parte Pfeiffer, 1962, C.D. 408 (1961). In the instant case, the apparatus in which the oxide/nitride/oxide stack is formed in not manipulative of the method.

If it is thought somehow that the structure limitations are manipulative of the invention, then this may be a difference. **Van Zant** teaches the benefits of using RTP, RTP-CVD (pp. 179-181), and cluster tools (pp. 480-481).

Further in regard to claim 5, **Van Zant** teaches that RTP, in general, is beneficial for reducing the thermal budget in the formation of semiconductor devices (p. 180, first sentence). On p. 181, **Van Zant** particularly states that rapid thermal wet (steam) oxidation is known and also states that RTP-LPCVD of silicon nitride is known. It would have been obvious for one of ordinary skill in the art, at the time of the invention to form the dielectric stack (oxide/nitride/oxide) of **Okuyama** in an RTP and RTCVD chamber to take advantage of the beneficial reduction in thermal budget, as taught by **Van Zant**.

Further in regard to claim 6, **Van Zant** teaches that clustering tools for automation of process steps reduces time and improves cleanliness and makes better products (i.e.

semiconductor devices). (See p. 481.) **Van Zant** also teaches the benefits of using a single wafer cluster tool on p. 486, indicating that single wafer apparatus provides better uniformity and easier process control for larger wafers than does batch wafer processing. It would have been obvious to one of ordinary skill in the art at the time of the invention to form the semiconductor device of **Okuyama** in a single-wafer cluster tool to take advantage of easier processing, better uniformity, improved cleanliness, and better products, each as taught by **Van Zant**.

Further in regard claim 8, it would be obvious to one of ordinary skill to provide hydrogen and oxygen to the RTP or single-wafer cluster tool to perform the wet oxidation of **Okuyama** because **Van Zant** teaches that *in-situ* generation of steam is cleaner and better controlled and because cluster tools and/or RTP tools provide better control of processes with reduced thermal budget, as just noted above.

Regarding claim 7, although **Okuyama** does not teach the method by which the nitride layer is deposited, **Van Zant** teaches the RTP-LPCVD of nitride is beneficial for, at least, reducing the thermal budget over non-RTP methods. It would have been obvious for one of ordinary skill in the art, at the time of the invention to deposit the nitride layer of **Okuyama** by RTCVD, as taught by **Van Zant**, to reduce the thermal budget in the fabrication of the semiconductor device.

Regarding claim 9, as noted above, **Okuyama** uses the claimed temperature for the wet oxidation, 950 °C (col. 4, lines 48-54).

Regarding claims 10 and 11, **Okuyama** discloses that the ratio of flow rate ratio of the silicon-containing compound to ammonia is about 1:30 in one embodiment, and that the silicon-containing compound is silane or dichlorosilane (col. 6, lines 6-39). This ratio of flow rates falls

within Applicant's claimed range of 1:100 to 1:5. **Okuyama** in view of **Van Zant** fails to indicate the specific flow rate. Given that some flow rate is used and that the thickness of the deposited silicon nitride layer falls exactly within the instantly claimed range, the section of the flow rates would be a matter of routine optimization to select the flow rates to form equal thicknesses. Although the ranges disclosed in **Okuyama** do not fall exactly within the claimed ranges, these claims are *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. In re Woodruff, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also In re Huang, 40 USPQ2d 1685, 1688(Fed. Cir. 1996)(claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and In re Aller, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious). It would have been obvious for one of ordinary skill in the art, at the time of the invention to choose flow rates for the ammonia and silicon-containing compound which are best for the process of forming the silicon nitride layer, according to precedent. Moreover, the flow rates are a function of the CVD reaction chamber and would be varied from one chamber to the next to optimize the process.

Regarding claims 12 and 13, the thicknesses disclosed in **Okuyama** fall within or overlap the claimed thicknesses for the silicon nitride and top oxide layers, as noted above. The exact ranges are obvious over the applied case law, as just noted.

Response to Arguments

6. Applicant's arguments with respect to all active claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at (703) 308-4940 or by e-mail at carl.whitehead@uspto.gov. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

EK

December 14, 2002

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